

Replacement Sheets 10 to 13

I claim:

**27. A method** for reducing fuel density while increasing combustion air density, without effecting specified fuel or air volumes, thereby significantly changing the ratio of fuel mass versus combustion air mass, hence oxygen mass, during the process of ignition and combustion of fluid hydrocarbon fuels ~~such as~~ including natural gas and propane gas ~~and the like~~, in combustion mechanisms having a combustion area and at least one burner therein for converting said fuel into energy, such as heat, thrust or torque, comprising:

- a) providing fluid hydrocarbon fuel as fuel for said combustion mechanism;
- b) directing said fuel through the fuel supply conduit defining a ~~first~~ heat exchanger assembly that extends through a ~~first~~ heat transfer zone related to the combustion mechanism;
- c) reducing the density of said fuel by heating the fuel as it flows through said ~~first~~ heat exchanger assembly to an optimal fuel operating temperature level ranging between ~~100~~ 165 degrees Fahrenheit and the fuel's flash point or auto ignition level;
- d) maintaining a constant volume of density reduced fuel to the combustion area of said combustion mechanism;
- e) providing combustion air for the combustion process in said combustion mechanism;
- f) directing said combustion air through an air supply conduit defining an ~~second~~ heat exchanger assembly that ~~extends through a second~~ is operated by a heat transfer zone of said combustion mechanism;
- g) increasing the density of said combustion air by cooling the combustion air as it flows through said ~~second~~ heat exchanger assembly to an optimal air operating temperature level of between plus 50 and minus ~~25~~ 40 degrees Fahrenheit;
- h) maintaining a constant volume of density increased combustion air to the combustion area of said combustion mechanism.

**28. A method** according to Claim 27, wherein the density reduction of the fuel is stabilised with an insulating or heat storage material forming part of the heat exchanger assemblies.

29. A method according to Claim 27, wherein at least one of said heat transfer zones is related to the exhaust gas vent area of the combustion mechanism.
30. A method according to Claim 27, wherein at least one of said heat transfer zones is related to the combustion area of the combustion mechanism.
31. A method according to Claim 27, wherein said heat transfer zones are operated from a source other than the combustion or exhaust gas vent area of the combustion mechanism.
32. A method according to Claim 27, wherein said preselected optimal fuel operating temperature range is within the preselected general fuel operating temperature range from ~~425~~ 165 degrees to 900 degrees Fahrenheit.
33. A method according to Claim 27, wherein the combustion mechanism converts the oxidation mixture of fuel and air into a high temperature, high velocity combustion product to operate a related energy transfer system.
34. A method according to Claim 27, wherein the combustion mechanism is a furnace for commercial or industrial use.
35. A method according to Claim 27, wherein the combustion mechanism is a process heater or commercial or industrial use.
36. A method according to Claim 27, wherein at least one of the two heat exchanger assemblies is operational.
37. A method according to Claim 27, wherein the fluid hydrocarbon fuel includes a suspended coal dust, or a coal dust slurry.
38. A method according to Claim 27, wherein the fluid hydrocarbon fuel includes a liquid fuel.
39. A device for reducing fuel density while increasing combustion air density, without effecting specified fuel or air volumes, thereby significantly changing the ratio of fuel mass versus combustion air mass, hence oxygen mass, during the process of ignition and combustion of fluid hydrocarbon fuels ~~such as~~ including natural gas and propane gas ~~and the like~~, in combustion mechanisms having a combustion area and at least one burner therein for converting said fuel into energy, such as heat, thrust or torque, comprising:
- a) a fuel supply conduit defining a ~~first~~ heat exchanger assembly located in a heating zone related to the combustion area of the mechanism, providing the means to

- maintain a constant supply of fluid hydrocarbon fuel to the combustion area of said mechanism at a preselected optimal operating temperature level ranging between ~~400~~ 165 degrees Fahrenheit and the fuel's flash point or auto ignition level;
- b) a combustion air supply conduit defining a ~~second~~ heat exchanger assembly located in a cooling zone related to the combustion mechanism, providing the means to maintain a constant volume of combustion air to the combustion area of said mechanism at a preselected optimal operating temperature level ranging between plus 50 and minus ~~25~~ 40 degrees Fahrenheit.
40. A device according to Claim 39, wherein an insulating material forms part of said heat exchanger assemblies in order to balance any temperature fluctuations occurring in the heat transfer zones.
41. A device according to Claim 39, wherein at least one heat transfer zone is related to the exhaust gas vent area of the combustion mechanism.
42. A device according to Claim 39, wherein at least one heat transfer zone is related to the combustion area of the combustion mechanism.
43. A device according to Claim 39, wherein at least one of the heat transfer zones ~~are~~ is related to an operating source other than the combustion or exhaust gas vent area of the combustion mechanism.
44. A device according to Claim 39, wherein said means to maintain a continuous volume of fuel to the burners in the combustion area of the mechanism at said optimal fuel temperature level operates within a preselected operating temperature range from above ~~125~~ 165 degrees and 900 degrees Fahrenheit.
45. A device according to Claim 39, wherein a preselected volume of combustion air is routed through a contained duct system which provides temperature control and the means for density increase of said combustion air volume by cooling the air to a preselected temperature range below ambient prior to combustion.
46. A device according to Claim 39, which provides the means for the combustion mechanism to convert an oxidation mixture of fuel and air into a high temperature, high velocity combustion product for the purpose of operating a related energy transfer system.
47. A device according to Claim 39, wherein the fluid hydrocarbon fuel is a fuel other than natural gas or propane gas.

48. A device according to Claim 39, wherein at least one of the two heat exchanger assemblies is operational.